We Claim:

1. A method of dry etching a PCMO stack, comprising:

preparing a substrate;

depositing a barrier layer;

depositing a bottom electrode;

depositing a PCMO thin film;

depositing a top electrode;

depositing a hard mask layer;

applying photoresist and patterning;

etching the hard mask layer;

dry etching the top electrode;

dry etching the PCMO layer in a multi-step etching process;

dry etching the bottom electrode; and

completing the PCMO-based device.

2. The method of claim 1 wherein said dry etching the top electrode includes etching using a gas mixture of Ar, O_2, and a gas taken from the group of gases consisting of Cl_2, BCl_3, CCl_4, $SiCl_4$, and a combination thereof, wherein the percentage of the oxygen is in a range of between about 1% to 50%, in a preferred range of between about 5% to30%; the percentage of Ar is in a range of between about 5% to 80%, and in a preferred range of between about 40% to 80%; and wherein the remaining gas component consists of a Cl-containing gas.

3. The method of claim 2 wherein said dry etching includes providing a gas flow rate of between about 20 sccm to 100 sccm, and a preferred flow rate of between about 40 sccm to 70 sccm; at a pressure of between about 1 mTorr and 50 mTorr, and a preferred pressure of between about 3 mTorr to 10 mTorr; at a microwave power of between about 400 W to 1000 W, and a substrate RF bias power is between about 10 W to 1000 W; and at a substrate temperature of between about -50°C to 500°C.

4. The method of claim 1 wherein said dry etching of the PCMO layer includes a first etching step uses an etching chemistry consisting of Ar and O_2, and a chlorine-containing gas and a second etching step uses an etching chemistry consisting of Ar and O_2.

5. The method of claim 4 wherein said first etching step and said second etching step are alternately applied until the PCMO is etched.

6. The method of claim 4 wherein said dry etching the PCMO layer includes a two-step etching process, wherein the first etching step includes etching the PCMO layer using a gas mixture of Ar, O_2, and a gas taken from the group of gases consisting of Cl_2, BCl_3, CCl_4, $SiCl_4$, and a combination thereof, wherein the percentage of the oxygen is in a range of between about 1% to 50%, in a preferred range of between about 5% to30%; the percentage of Ar is in a range of between about 5% to 80%, and in a preferred range of between about 40% to 80%; and wherein the remaining gas component consists of a Cl-containing gas, and which further includes providing a gas flow rate of between about 20 sccm to 100 sccm, and a preferred flow rate of between about 40 sccm to 70 sccm; at a pressure of between about 1 mTorr and 50 mTorr, and a preferred pressure of between about 3 mTorr to 10 mTorr; at a microwave power of between about 400 W to 1000 W, and a substrate RF bias power is between about 10 W to 1000 W; and at a substrate temperature of between about -50°C to 500°C.

7. The method of claim 6 wherein the second PCMO etching step includes etching the PCMO layer using a gas mixture consisting of Ar and O_2, wherein the percentage of the oxygen is in a range of between about 1% to 50%, in a preferred range of between about 5% to30%; and the percentage of Ar is in a range of between about 5% to 80%, and in a preferred range of between about 40% to 80%; and which further includes providing a gas flow rate of between about 20 sccm to 100 sccm, and a preferred flow rate of between about 40 sccm to 70 sccm; at a pressure of between about 1 mTorr and 50 mTorr, and a preferred pressure of between about 3 mTorr to 10 mTorr; at a microwave power of between about 400 W to 1000 W, and a substrate RF bias power is between about 10 W to 1000 W; and at a substrate temperature of between about -50°C to 500°C.

8. The method of claim 1 wherein said dry etching the bottom electrode includes etching using a gas mixture of Ar, O_2, and a gas taken from the group of gases consisting of Cl_2, BCl_3, CCl_4, $SiCl_4$, and a combination thereof, wherein the percentage of the oxygen is in a range of between about 1% to 50%, in a preferred range of between about 5% to30%; the percentage of Ar is in a range of between about 5% to 80%, and in a preferred range of between about 40% to 80%; and wherein the remaining gas component is comprised of a Cl-containing gas.

9. The method of claim 8 wherein said dry etching includes providing a gas flow rate of between about 20 sccm to 100 sccm, and a preferred flow rate of between about 40 sccm to 70 sccm; at a pressure of between about 1 mTorr and 50 mTorr, and a preferred pressure of between about 3 mTorr to 10 mTorr; at a microwave power of between about 400 W to 1000 W, and a substrate RF bias power is between about 10 W to 1000 W; and at a substrate temperature of between about -50°C to 500°C.

10. The method of claim 1 which further depositing a layer of Ti, having a thickness in the range of between about 5 nm to 50 nm between the top electrode and the hard mask to enhance the adhesion of the hard mask.

11. A method of dry etching a PCMO stack, comprising:

preparing a substrate;

depositing a barrier layer;

depositing a bottom electrode;

depositing a PCMO thin film;

depositing a top electrode;

depositing a hard mask layer;

applying photoresist and patterning;

etching the hard mask layer;

dry etching the top electrode;

dry etching the PCMO layer in a multi-step etching process, including a first etching step using an etching chemistry consisting of Ar, O_2 and a chlorine-containing gas, and a second etching step uses an etching chemistry consisting of Ar and O_2;

dry etching the bottom electrode;

wherein said dry etching of the top electrode, of the bottom electrode and the first PCMO etching step includes etching using a gas mixture of Ar, O_2, and a gas taken from the group of gases consisting of Cl_2, BCl_3, CCl_4, $SiCl_4$, and a combination thereof, wherein the percentage of the oxygen is in a range of between about 1% to 50%, in a preferred range of between about 5% to30%; the percentage of Ar is in a range of between about 5% to 80%, and in a preferred range of between about 40% to 80%; and wherein the remaining gas component is comprised of a Cl-containing gas; and

completing the PCMO-based device.

12. The method of claim 11 wherein said dry etching of the top electrode, of the bottom electrode and the first PCMO etching step includes providing a gas flow rate of between about 20 sccm to 100 sccm, and a preferred flow rate of between about 40 sccm to 70 sccm; at a pressure of between about 1 mTorr and 50 mTorr, and a preferred pressure of between about 3 mTorr to 10 mTorr; at a microwave power of between about 400 W to 1000 W, and a substrate RF bias power is between about 10 W to 1000 W; and at a substrate temperature of between about -50°C to 500°C.

13. The method of claim 11 wherein the second etching step includes etching the PCMO layer using a gas mixture consisting of Ar and O_2, wherein the percentage of the oxygen is in a range of between about 1% to 50%, in a preferred range of between about 5% to30%; and the percentage of Ar is in a range of between about 5% to 80%, and in a preferred range of between about 40% to 80%; and which further includes providing a gas flow rate of between about 20 sccm to 100 sccm, and a preferred flow rate of between about 40 sccm to 70 sccm; at a pressure of between about 1 mTorr and 50 mTorr, and a preferred pressure of between about 3 mTorr to 10 mTorr; at a microwave power of between about 400 W to 1000 W, and a substrate RF bias power is between about 10 W to 1000 W; and at a substrate temperature of between about -50°C to 500°C.

14. The method of claim 11 wherein said first etching step and said second etching step are alternately applied until the PCMO is etched.

15. The method of claim 11 which further depositing a layer of Ti, having a thickness in the range of between about 5 nm to 50 nm between the top electrode and the hard mask to enhance the adhesion of the hard mask.